Registration of Four Low-Phytate/Wild Type Pairs of Barley Germplasms

P. Bregitzer* and V. Raboy

Four pairs of barley (*Hordeum vulgare* L.) sib lines derived from low-phytate mutants have been developed and released in 2007 by The Agricultural Research Service, U.S. Department of Agriculture. Each pair consists of a low phytate (LP) and a wild-type (WT) line. These lines are designated LP1 (Reg. No. GP-181, PI 644105) and LP1-WT (Reg. No. GP-182, PI 644106), LP2 (Reg. No. GP-183, PI 644107) and LP2-WT (Reg. No. GP-184, PI 644108), LP3 (Reg. No. GP-185, PI 644109) and LP3-WT (Reg. No. GP-186, PI 644110), and LP4 (Reg. No. GP-187, PI 644111) and LP4-WT (Reg. No. GP-188, PI 644112). These lines will be useful for the production of low phytate barley cultivars and for genetic and biochemical studies.

Phytate is a phosphorus storage compound that cannot be efficiently digested by non-ruminant animals such as pigs, chickens, fish, and humans, and it is an effective chelator of nutritionally important mineral cations. Diets high in phytate are associated with mineral deficiencies, and high levels of phosphorus excretion into the environment that contribute significantly to water quality problems. Low phytate barley lines have been shown to improve mineral nutrition, and to provide an effective genetic approach to reducing the discharge of phosphorus into the environment via the reduction of fecal phosphorus. These details are reviewed by Bregitzer and Raboy (2006a, 2006b).

All eight lines are backcross derivatives of mutant plants generated by sodium azide treatment of 'Harrington' (Harvey and Rossnagel, 1984). The original mutations were identified based on high levels of seed inorganic phosphorus, which was a consequence of the reduction in phytate without, or with only slight, changes in total phosphorus levels. Each of these lines was developed by backcrossing their mutant parent line to the WT parent (Harrington). Selection of mutant progeny for each crossing cycle was based on high grain inorganic phosphorus levels. After the final backcross cycle, selections of multiple LP and WT sib lines were made based on visual similarity to Harrington. Within each mutant class, WT and LP sib lines were bulked to produce the LP/WT pairs that are the subject of this release.

The LP1 and LP1-WT lines were produced, respectively, by bulking six $BC_4F_{2:3}$ LP sib lines possessing the *lpa-1* mutation and six $BC_4F_{2:3}$ WT sib lines possessing the WT allele. The *lpa1-1* mutation is associated with a reduction in phytate of approximately 50% coupled with nearly proportional increases in inorganic phosphorus, and a reduction in total phosphorus of approximately 10% (Dorsch et al., 2003). The agronomic, malting, and grain phosphorus characteristics of LP1 and LP1-WT were determined based on the performance of six LP and six WT sib lines in replicated, small-plot yield trials conducted at six location-years in 2002 and 2003. Details of the experimental design, data, and data analysis can be found in Bregitzer and Raboy (2006a, 2006b); an abbreviated description of the results is presented below. Variability among the six sib lines within each class (LP or WT) was not significant. The agronomic performance and malting qualities of LP1-WT and Harrington were similar. LP1 was similar to Harrington except for reductions in test weight (3%), diastatic power (13%), and malt β-glucan (56%). Grain β-glucan was not affected. Under conditions of moisture limitation, percentage plump kernels showed a 10% reduction. The *lpa1-1* mutation is the source of the low phytate phenotype in 'Herald' (Bregitzer et al., 2007).

The LP2 and LP2-WT lines were produced, respectively, by bulking fourteen $BC_3F_{2:3}$ LP sib lines possessing the *lpa2-1* mutation and nine $BC_3F_{2:3}$ WT sib lines possessing the WT allele. The *lpa2-1* mutation is associated with a reduction in phytate of approximately 40% coupled with proportional increases in a pool of nonphytate phosphorus that includes inositol phosphates with five or fewer phosphate esters; total phosphorus is unchanged (Dorsch et al., 2003). The agronomic, malting, and grain phosphorus characteristics of LP2 and LP2-WT were determined based on the performance of six LP and six WT sib lines in replicated, small-plot yield trials conducted at six location-years in 2002 and 2003. Details of the experimental design, data, and data analysis can be found in Bregitzer and Raboy (2006a, 2006b); an abbreviated description of the results is presented below. Variability among the six sib lines within each class (LP or WT) was not significant. The agronomic and malting characteristics of LP2-WT and Harrington were similar. LP2 was similar to Harrington for agronomic characteristics under optimal environmental conditions, but showed reduced yield (24%), test weight (2%) and percentage plump kernels (16%) under conditions of moisture limita-

P. Bregitzer and V. Raboy, USDA-ARS, National Small Grains Germplasm Research Facility, 1691 S. 2700 W., Aberdeen, ID, 83210.
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tion. The malting characteristics of LP2 were similar to Harrington except for a reduction in diastatic power (19%).

The LP3 and LP3-WT lines were produced, respectively, by bulking eight $BC_3F_{2:3}$ LP sib lines possessing the *lpa3-1* mutation and ten $BC_3F_{2:3}$ WT sib lines possessing the WT allele. The *lpa3-1* mutation is associated with a reduction in phytate of approximately 65% coupled with proportional increases in inorganic phosphorus; total phosphorus is unchanged (Dorsch et al., 2003). The agronomic, malting, and grain phosphorus characteristics of LP3 and LP3-WT were determined based on the performance of six LP and six WT sib lines in replicated, small-plot yield trials conducted at six location-years in 2002 and 2003. Details of the experimental design, data, and data analysis can be found in Bregitzer and Raboy (2006a, 2006b); an abbreviated description of the results is presented below. Variability among the six sib lines within each class (LP or WT) was not significant. The agronomic and malting characteristics of LP3-WT and Harrington were similar. LP3 was similar to Harrington for agronomic characteristics under optimal environmental conditions except for reduced test weight (3%), but showed reduced yield (26%), test weight (3%) and percentage plump kernels (19%) under conditions of moisture limitation. The malting characteristics of LP3 were similar to Harrington except for a reduction in diastatic power (19%) and an increase in malt β-glucan (57%). Grain β-glucan was not affected.

The LP4 and LP4-WT lines were produced, respectively, by bulking 22 $BC_2F_{2:3}$ LP sib lines possessing the M955 mutation and 11 $BC_2F_{2:3}$ WT sib lines possessing the WT allele. The M955 mutation is associated with a reduction in phytate of approximately 95% coupled with proportional increases in inorganic phosphorus; total phosphorus is unchanged (Dorsch et al., 2003). The agronomic, malting, and grain phosphorus characteristics of LP4 and LP4-WT were determined based on the performance of six LP and six WT sib lines in replicated, small-plot yield trials conducted at six location-years in 2002 and 2003. Details of the experimental design, data, and data analysis can be found in Bregitzer and Raboy (2006a, 2006b); an abbreviated description of the results is presented below. Variability among the six sib lines within each class (LP or WT) was not significant. The agronomic and malting characteristics of LP4-WT and Harrington were similar. LP4 was inferior to Harrington for agronomic characteristics under optimal and moisture-limited environmental conditions, and showed reductions in (respectively for optimal and moisture-limited environments): yield, 13% and 44%; test weight, 5% and 5%; and percentage plump kernels, 14% and 30%. The malting characteristics of LP4 differed from those of Harrington for diastatic power (29% reduction) and malt β-glucan (49% reduction). Grain β-glucan showed a slight (6%) decrease.

Small quantities of these lines can be obtained from the corresponding author for five years after publication, or from the National Plant Germplasm System (www.ars-grin.gov/npgs/ verified 10 July 2007) where it will be maintained for long-term availability. It is requested that appropriate recognition of source be given when this germplasm contributes to research or development of new breeding lines or cultivars.

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